

BECKMAN® / FIRST IN HYBRID SOFTWARE



Beckman®

COMPUTER OPERATIONS

Beckman hybrid software can be classified into two general categories: Programming Systems and Utility Systems. A programming system such as an assembler or compiler simplifies the programmer's task in specifying a sequence of operations for solving his problem. The Utility Systems aid in specific tasks, such as a program for automatically performing a static check of the analog subsystem of a hybrid calculation.

HYBRID PROGRAMMING SYSTEMS

HYBRID FORTRAN II

The Beckman hybrid computer, when incorporating either a 900 or 9000 Series SDS digital subsystem, utilizes Hybrid Fortran II. Special instructions to the computer, such as input or output commands and data specifications, use names or mnemonics easily associated with corresponding English terms. Expressions are used that are quite similar to accepted mathematical notations involving the operational relationships of constants, variables, and function.

The HYBRID FORTRAN II processor takes programs written in the HYBRID FORTRAN II language and produces or compiles machine-language programs for execution on a Beckman Integrated Computing System. To minimize the cost of compiling — a major expense of today's computing installations — HYBRID FORTRAN II emphasizes compiling speed. In addition, features are included for use at run-time to reduce the cost and time required for program checkout and execution.

As is the case with all Beckman hybrid programming systems, the generated code is completely compatible with interrupt operation. In the Hybrid Fortran II system many statements beyond the scope of normal Fortran are acceptable. These are listed below:

1. All ASA Fortran II standard definitions
2. Hybrid Fortran statements

For example:

Intra Computer Data Transfer
Computer Set Up and Check Out
Computer Mode Control

3. Logical Statements

These follow the ASA Fortran IV definitions and include:

AND, OR, NOT and Exclusive OR (EOR)

4. In-Line Symbol

By placing an "S" in column one the statement is

interpreted as Symbol and one line of machine code is generated.

5. Interrupt Connections

By use of the statements, Connect and Release, subroutines may be linked to and released from interrupt lines.

HYBRID FORTRAN IV

The HYBRID FORTRAN IV system, an extension of HYBRID FORTRAN II, allows you more flexibility in program implementation and features an improved language structure. The HYBRID FORTRAN IV compiler accepts a source program written in a language closely resembling ordinary mathematical notation. Designations such as complex variables and double-precision real-time variables eliminate the need for declaring the mode of a statement when writing the program. Also, decisions can be based on Boolean variables. Subroutines and functions may refer to storage arrays with dimensions, allowing flexibility in subprogram design and obviating recompilation to change dimension statements.

Other benefits, such as rapid compilation speed and efficiency of the object program, also contribute to the effectiveness of HYBRID FORTRAN IV.

HYBRID EXECUTIVE

The HYBRID EXECUTIVE system automates the processing of intermixed programs, compilations, and executions with a minimum of operator intervention. The system utilizes magnetic tape units for recording of programming systems and utility systems.

By reducing operator intervention, HYBRID EXECUTIVE significantly reduces operating errors. In addition, all operator-initiated messages are recorded at the typewriter to provide visual verification and permanent logging.

UTILITY SYSTEMS

A comprehensive library of HYBRID UTILITY programs is provided to insure you of efficient, economical use of a Beckman Integrated Computing System. These programs provide the benefits of ease of use, reduction of programming time, and automatic operation.

The following are only a few of the subroutines included in the HYBRID UTILITY system, but they graphically illustrate the importance of utility programs specifically designed for efficient hybrid computation.

ANACHECK

This Fortran coded program performs AUTOMATICALLY a static checkout of the analog subsystem against a specified analog flow chart listing. This automatic checkout eliminates the need for the operator's time-consuming supervision of problem verification. ANACHECK not only checks patchboard wiring and function of computing elements, but indicates if proper contact is being made on all connections . . . AUTOMATICALLY.

REQUEST PACKAGE

A special feature of the Beckman Integrated Computing System is the Request Package. The last portion of core memory storage is allocated to a special program which allows you convenient access to the analog subsystem via the input/output typewriters.

This program permits a wide choice of monitor and control functions all of which can be controlled from the typewriter keyboard. Some typical functions are:

- Read and type out a single analog point, such as an amplifier output.
- Read and punch a tape of series of analog points, such as all potentiometer coefficients.
- Set a series of potentiometer coefficients from a pre-punched paper tape.
- Place the analog subsystem in a mode, such as compute.
- Set up a digitally set function generator channel.

The Request Package is a man-machine communication, and therefore a low priority entered via a low priority interrupt. If while the Request Package is being serviced a higher priority interrupt occurs, the program will be shifted to the higher priority program. Upon completion of this higher priority task the program control will be returned to the Request Package. This use of priority interrupts allows you to use the Request Package without disturbing the main program.

MAINTENANCE AND DIAGNOSTIC PROGRAMS

Each Beckman Integrated Computing System is provided with a set of programs designed to facilitate maintenance and pinpoint equipment malfunctions. These programs are tailored to meet the specific requirements of the equipment configuration involved. The programs are used during scheduled maintenance periods to insure that all elements are functional and operating within prescribed tolerances. These programs also can be used to speed the diagnosis and repair of system malfunctions.

Digital Subsystem — The Examiner System is a complete diagnostic package designed to exercise and/or diagnose the memory, digital computer logic, buffer, and associated peripheral equipment.

The Memory Diagnostics program tests the memory by generating several "Worst Case" patterns to exercise the memory and monitor it for errors. Other features of the program are designed to aid you in determining the actual cause of some of the more subtle memory failures.

The Instruction Diagnostics program tests every gate and flip-flop of the instruction logic by executing the entire instruction repertoire individually and monitoring the results for errors. Information about the actual gate of the flip-flop can be readily deduced by using some of the special features of the program. In many cases, you not only can determine the circuit but the actual component that failed.

The Peripheral Diagnostics program tests the ability of the typewriter input and output, tape punch, and card reader to generate or receive all acceptable characters in one, two, three, and four-character mode, while monitoring for errors.

Analog Subsystem — The Analog Subsystem Diagnostics package is designed to utilize the digital subsystem for program control and type-out of individual component failure. Program design allows you to perform checks on the entire complement of analog equipment automatically, or to select individual components or groups of components. The system is tested by placing hard-wired patchboards on the analog subsystem and loading the diagnostic program. Diagnostics are also provided in this package for the test lines, signal lines, system interrupts, digital-to-analog link, and analog-to-digital link.

The system is composed of five diagnostic subprograms: (1) Amplifier, (2) Servo-set Potentiometer, (3) Electronic Multipliers, (4) Sin-Cos Function Generator, and (5) Electronic Comparators and Patchable Logic.

In the Amplifier Diagnostics program the operational amplifiers are tested under load conditions and any amplifier that does not meet prescribed specifications is noted by type-out. All input and feedback networks, including the spare networks associated with the operational amplifiers, are checked using the built-in computer check modes, such as integrand check and integrator check. Any components out of tolerance are noted by an output at the typewriter. Integrators associated with the system are checked for drift during compute mode.

In the Potentiometer Diagnostics program the potentiometers are set to several different values, and any potentiometer that will not set to each value ± 20 millivolts is noted by the type-out of *pot will not set*.

In the Electronic Multipliers Diagnostics program the Sin-Cos circuits are provided with inputs that check operation in each quadrant for excessive errors. Any function that does not meet specifications is described by typewriter output.

In the electronic Comparators and Patchable Logic Diagnostics programs, tests are made of the comparators and logic levels. Inputs to the patchable logic are provided through the signal lines and are generated by the digital section. This test is of the go, no-go type.

The Analog Subsystem Diagnostics program is designed in such a way that errors do not have to be corrected before continuing program operation.

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Beckman offers you the first standard software packages specifically developed for hybrid computation. With all Beckman Integrated Computing Systems — regardless of size — you are furnished a complete standard library of hybrid software — and at NO EXTRA COST! You are not burdened by the time-consuming task and high cost of developing specialized programs for your specific or varying applications.

Beckman software packages consist of comprehensive programs which assure you of the most efficient man-machine communication. You concentrate on your simulation problems — not on the hardware. Programs are incorporated into a flexible, easy-to-use system which simplifies and speeds the total programming process from setup and checkout to actual computation and analysis. In addition, programs consisting of maintenance and diagnostic routines are provided; this insures you minimum down time and optimum performance of your integrated computing system.

Beckman hybrid software never becomes obsolete. You continue to receive — free of charge — all future software developments which can be used with your Beckman Integrated Computing System. The result is a Beckman software program that gives the user ultimate control and flexibility, with efficiency that is unparalleled in the industry.

Today, the scientific digital computer has reached a high level of proficiency, due mainly to efficient software which simplifies and expedites man-machine communication. As a consequence, the programming of systems through the development of an appropriate language (software) represents the highest cost of operating a computer . . . a fact well known to the digital computer user.

With the advent of the sophisticated hybrid computer, the need for complete software remains paramount. In the past, analog users, who were concerned primarily with direct man-machine communication, considered software as a tool of the digital user. This is no longer true, as the analog user, aware of the benefits of hybrid computation, is placing more and more emphasis on the significance of hybrid software.

In a Beckman Integrated Computing System, software is designed to encompass the analog computer as well as the digital computer. This software involves much more than just "automatic control" of the analog computer or independent computing by the digital and analog elements. It provides programs that determine the configuration of both computing elements, automatically set and vary parameters, and automatically control all phases of operational modes and input/output data.

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